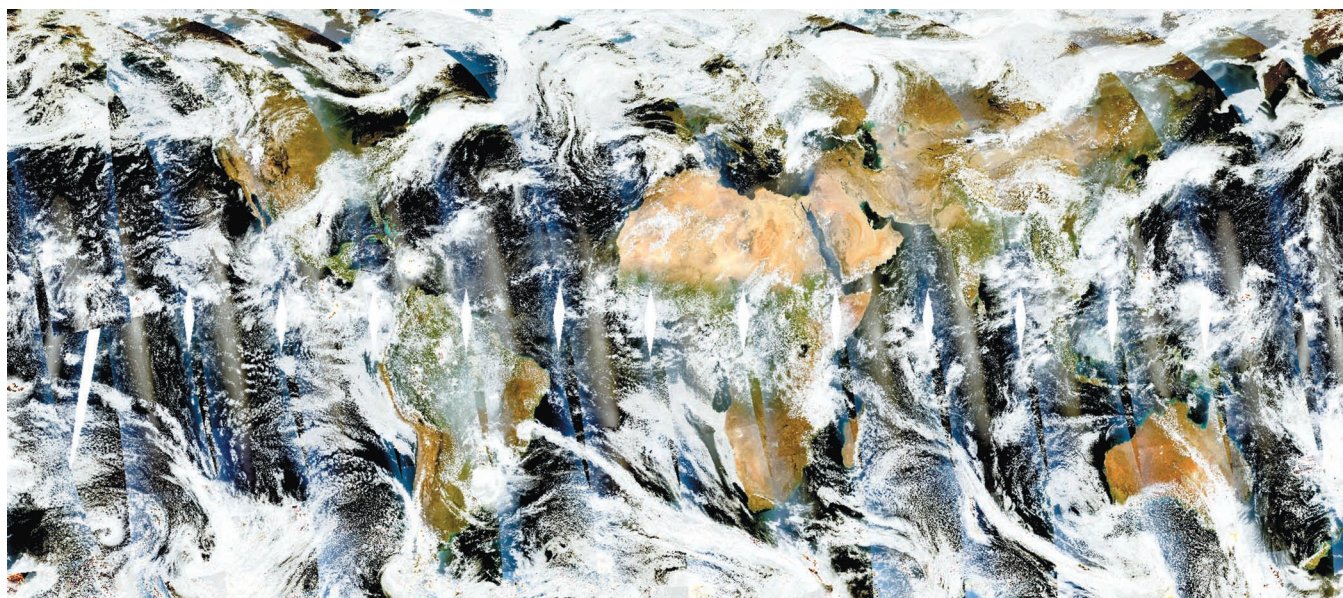# MODIS Data from the GES DISC DAAC
Moderate-Resolution Imaging Spectroradiometer (MODIS)
Goddard Earth Sciences (GES) Data and Information Services Center (DISC)
Distributed Active Archive Center (DAAC)

December 2002

Complete Day from MODIS/Terra and MODIS/Aqua
This global 5 km pixel resolution image was generated using MODIS visible bands 1, 4 and 3 from both the Terra and Aqua platforms. While the MODIS/Aqua data here is simply overlayed over MODIS/Terra, the image demonstrates the unique daily coverage achieved by the Terra and Aqua formation. This unprecedented, continuous, data flow of high quality and resolution is creating new horizons for Earth resources exploration. The image, created using the HDFLook tool, shows our planet on September 16, 2002. (Image created by the MODIS Data Support Team (MDST) at the GES DAAC)

Introduction

Through observations and measurements, scientists have recognized changes in Earth's atmosphere, land and oceans. There are indications that many natural changes are being accelerated by human activities, such as deforestation, biomass burning, and increased emissions due to industrial activities.

Many global measurements over long time periods are required to improve computer models that can accurately predict the causes and effects of climate change. The goal is to develop models of Earth's global dynamics (atmospheric, oceanic and terrestrial) and predict changes. Consequently, these data will assist policymakers worldwide in making sound decisions concerning protection and management of Earth's resources. With this goal in mind, NASA began a study of planet Earth called the Earth Observing System (EOS), which is comprised of a series of satellites, a computer network for processing, storing and distributing data, and teams of scientists to analyze these data.

As part of the EOS mission, the Terra and Aqua satellites were launched in December 1999 and in May 2002, respectively, and both satellites carry the Moderate-Resolution Imaging Spectroradiometer (MODIS) instrument. MODIS/Terra began collecting data on February 24, 2000, and MODIS/Aqua on June 24, 2002.

Terra and Aqua are the first two in a new series of satellites that bear several instruments with multi-spectral capability. The synergy between these data enables scientists to study features and processes from very small scales (tens of meters) to the global scale. With its sweeping 2,330 km-wide viewing swath, MODIS sees every point on the globe every two days in thirty-six discrete spectral bands, at 1-km resolution or better. For the first time, MODIS provides simultaneous measurements of the land, ocean and atmosphere at the same resolution. MODIS thus improves upon the heritage of sensors that includes AVHRR, CZCS, SeaWiFS and TOVS. The Terra and Aqua formation allows MODIS to provide unprecedented spatial and temporal coverage (see MODIS Terra/Aqua image on the back).

MODIS Science Data Products

The GES DAAC is responsible for the distribution of the Level 1 data, and the higher levels of all Ocean and Atmosphere products (Land products are distributed through the Land Processes (LP) DAAC, and the Snow and Ice products are distributed though the National Snow and Ice Data Center (NSIDC) DAAC). Ocean products include SST, concentrations of chlorophyll, pigment and coccolithophores, fluorescence, absorptions, and primary productivity. Atmosphere products include aerosols, atmospheric water vapor, clouds and cloud masks, and atmospheric profiles from 20 layers.

While most MODIS data products are archived in the Hierarchical Data Format-Earth Observing System (HDF-EOS 2.7) format, the ocean binned products and primary productivity products (Level 4) are in the native HDF4 format. MODIS Level 1 and 2 data are of the Swath type and are packaged in files representing five minutes of Terra viewing (scenes of approximately 2000 by 2330 km). Files for Level 3 and 4 are global products at daily, weekly, monthly or yearly resolutions. Apart from the ocean binned and Level 4 products, these are in Grid type, and the maps are in the Cylindrical Equidistant projection with a rectangular grid.

MODIS data have several levels of maturity. Most products are released with a provisional level of maturity and only announced as validated after rigorous testing by the MODIS Science Teams. MODIS/Terra Level 1, and all MODIS/Terra 11-µm SST products are announced as validated. At the time of this publication, the MODIS Data Support Team (MDST) is working with the Ocean Science Team toward announcing the validated status of the remainder of MODIS/Terra Ocean products. MODIS/Aqua Level 1 and cloud mask products are released with provisional maturity.

The MDST will announce the changes in maturity for all products on the MDST web site and in email newsletters. To subscribe to the email newsletters, please send a message to *modis@daac.gsfc.nasa.gov* requesting that you be added to the newsletter list. The URL for the MDST web site is:
http://daac.gsfc.nasa.gov/MODIS/

MODIS Data Access and Services

In order to provide expert assistance to both first-time and experienced users, the MDST was formed at the GES DAAC. The MDST mission is also to provide Web documentation and software tools to support the user community in their work with MODIS data, to keep users informed on new data releases, as well as to provide science software to run as extensions to the the EOS Data and Information System (EOSDIS) Core System (ECS) production line at the GES DAAC. MDST members play a key role in navigating users through the complex web of ECS

products and bringing the search and order process to a successful completion. Please send any science questions about MODIS to the MDST at *modis@daac.gsfc.nasa.gov*. The following are the search and order engines for MODIS data from GES DAAC.

Earth Observing System Data Gateway:
http://eos.nasa.gov/imswelcome/
This is a powerful interface which allows for cross-DAAC, cross-product, cross-platform search and order of remote sensing data from all DAACs and affiliated data centers. Numerous search criteria exist to narrow down available data sets.

Multiple Data Order Page:
http://daac.gsfc.nasa.gov/daac-bin/MODIS/Data_order.pl?PRINT=1
This is a convenient interface to MODIS data that was developed by the MDST. While it is a gateway to DAAC Search and Order, it saves significant time when users need to order different data types simultaneously, check the satellite overpass, examine cloud cover, and find browse imagery.

GES DAAC Search and Order:
http://daac.gsfc.nasa.gov/data/
Also known as WHOM, this search engine is familiar to users from earlier missions (AVHRR, TRMM, and SeaWiFS). The main advantages of this tool are the interface simplicity, the high speed of returning of search results, and most importantly, Level 1B on-demand channel subsetting and Ocean Level 3 parameter subsetting.

ECS Data Pool:
ftp://g0dps01u.ecs.nasa.gov/
The Data Pool uses 50 terabyte disk cache to hold selected MODIS and AIRS data types for a limited time, from weeks to two years depending on the data type demand and volume. However, small and popular data types like the MDST's 5-km Level 1B subset will be stored permanently. The goal is to increase the distribution capacity of ECS by significantly reducing the need to access the tape archive. In addition, user access to the data is made faster and easier. For those users who prefer direct command line access, anonymous ftp capability is provided.

Instrument Comparison (Wavelength and Bandwidth)

Visible and Near-Infrared Region

Suggested Tools for Visualizing and Mapping (registering) of MODIS Data
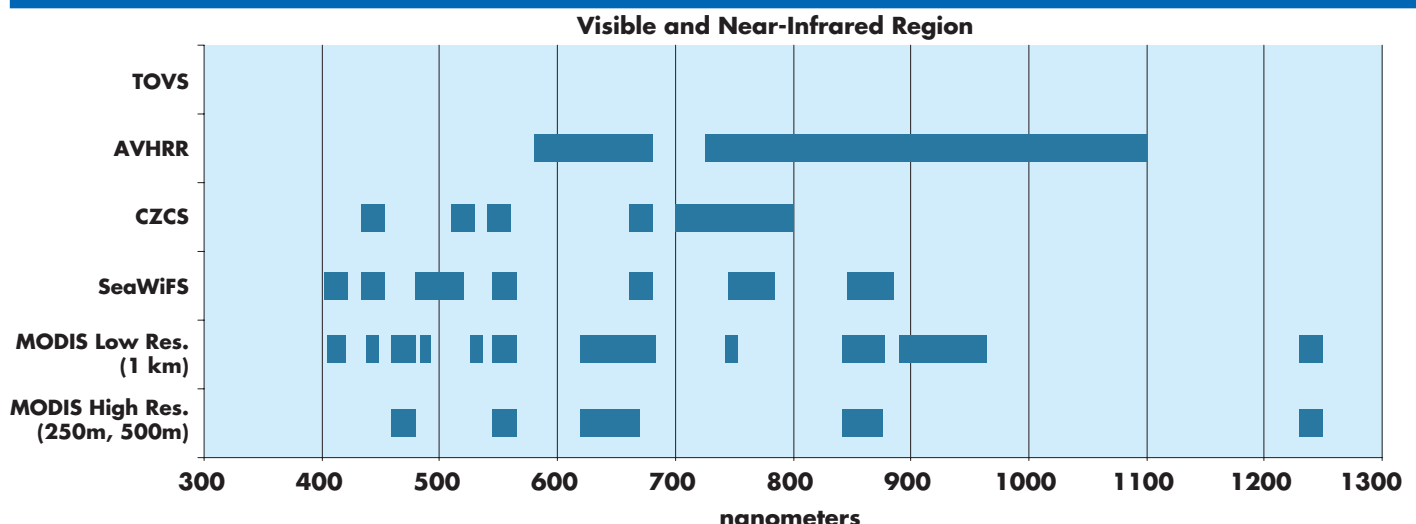
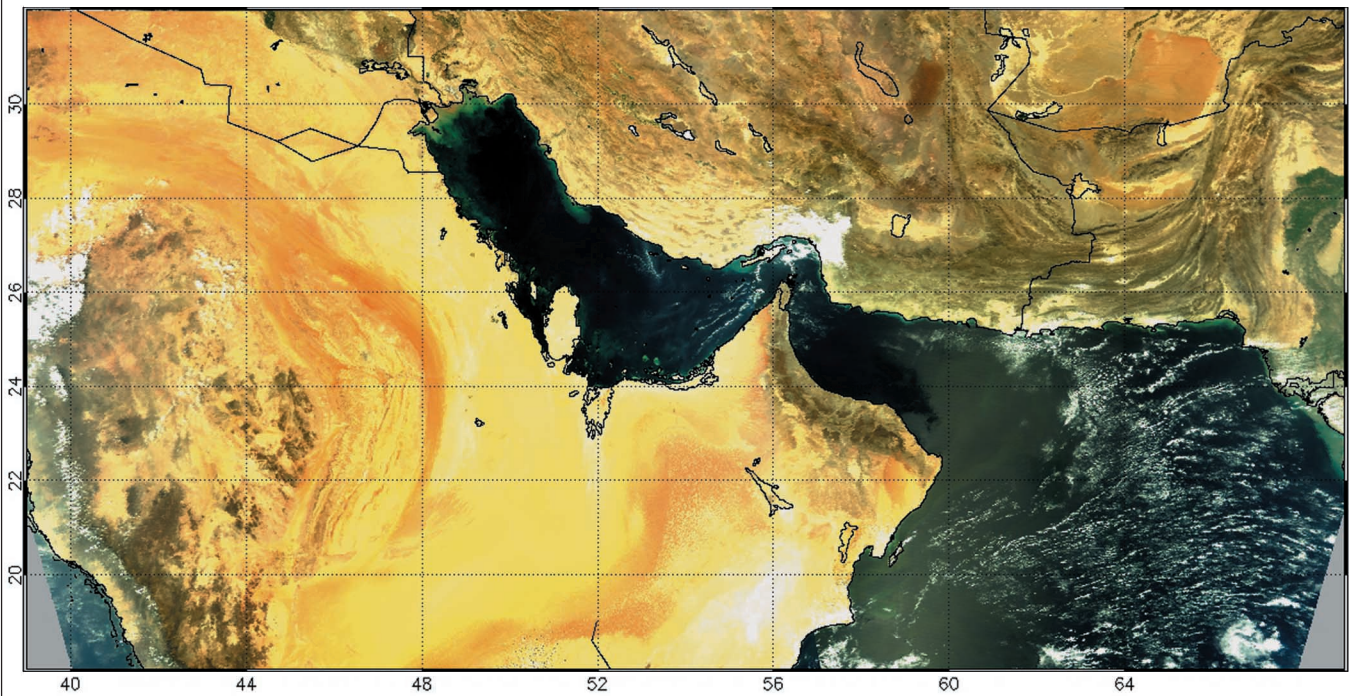In order to work with MODIS data, users need to have tools that suit their needs, experience and platforms. In their daily work, MDST members use several tools that fit most needs and they can provide guidance to users for these. The number of MODIS data tools is increasing, and the MDST web site provides a list of the ones developed at the GES DAAC as well as other scripts and software packages (freeware) that they have found very useful. Users are encouraged to test several of these options.
http://daac.gsfc.nasa.gov/MODIS/software.shtml

Other Useful WWW Links

MODIS Home Page:
http://modis.gsfc.nasa.gov/MODIS/

MODIS Oceans Home Page:
http://modis-ocean.gsfc.nasa.gov/

MODIS Atmosphere Home Page:
http://modis-atmos.gsfc.nasa.gov/

MODIS Characterization Support Team (MCST) Home Page:
http://www.mcst.ssai.biz/

Scientific Studies

The Terra and Aqua multi-sensor satellites orbit the Earth at the same altitude and orbital inclination, providing the same observational geometry. This orbital formation allows merging of data from the two MODIS instruments. The Terra platform has a 10:30 AM (local time) equatorial crossing time, enabling observations of the land and ocean surface with minimal cloud cover. In contrast, the Aqua equatorial crossing time of 1:30 PM (local time) allows observation of the development of planetary boundary layer and structure of clouds that form due to daily convective heating of the atmosphere. Measurements by other Aqua instruments are mainly focused on hydrological processes.

Sea Surface Temperature: The Sea Surface Temperature (SST) from MODIS can be used to observe and study oceanic currents in unprecedented detail. Oceanic currents are major conveyors of heat between low and high latitudes. SSTs are very important for estimation of the heat and mass exchange between the oceans and atmosphere. MODIS provides global coverage of day-time and night-time SSTs that will lead to a better understanding of global circulation of the atmosphere and oceans. The 11-µm SST data are announced as validated.

-5.0   3.0   11.0   19.0   27.0   35.0   sst, Deg C

Global weekly 11-um SST. The 11-µm SST products are announced as validated with an accuracy better than 0.5K, which can bring up astounding details in the full resolution images. Equatorial waves, Gulfstream eddies, and monsoon-related warming in the Persian Gulf can be seen even in this strongly reduced 36-km, Level 3, image from the week of September 14, 2002. (Image created by the MDST at the GES DAAC)

Chlorophyll Fluorescence: MODIS is able to measure the photosynthetic activity of marine plants (phytoplankton) by using a unique new band at 683 nm to measure chlorophyll fluorescence. The more plants fluoresce, the less energy they are able to use for photosynthesis. Thus, MODIS can map the distribution of phytoplankton and quantify their physiological state.

Atmospheric Water Vapor: The near-infrared total-column precipitable water algorithm is very sensitive to boundary-layer water vapor, since it is derived from attenuation of reflected solar light from the surface. This data product is essential to understanding the hydrological cycle, aerosol properties, aerosol-cloud interactions, energy budget, and climate. Of particular interest is the collection of water-vapor data above cirrus clouds, which has important applications to climate studies. MODIS will also provide finer horizontal-scale atmospheric water-vapor gradient estimates than are currently available from the Polar-orbiting Operational Environmental Satellites (POES).

Instrument Comparison (Wavelength and Bandwidth – continued)

Mid- and Thermal-Infrared Region

0   2   4   6   8   10   12   14   16
microns

Scientific Studies: Examples of Measurements

**A subset of the Complete Day (image on front cover) from MODIS/Terra and MODIS/Aqua**
The power of the flying formation of Terra and Aqua is demonstrated using this combined true color (bands 1,4 and 3) MODIS image from September 16, 2002. MODIS/Terra passed over the Gulf of Oman at 06:50 UTC, and three hours later MODIS/Aqua passed over the Persian Gulf, making possible stitching of the two overpasses in a single product. Thus, both platforms allow for unprecedented daily coverage. In the near future, users will be able to create their own combined products, similar to the above, for higher level science parameters like sea surface temperature, chlorophyll and aerosol concentrations, etc. (Image created by the MDST at the GES DAAC)
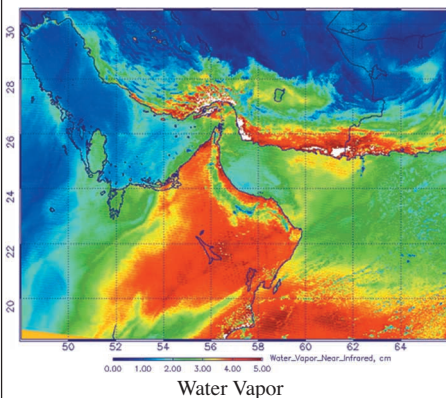
Water Vapor
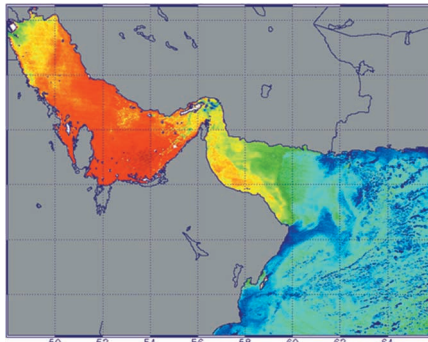
Sea Surface Temperature
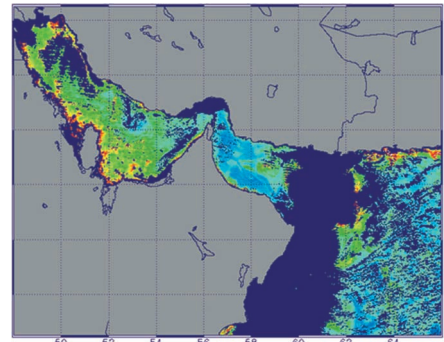
Chlorophyll

MODIS/Terra Atmosphere and Ocean Level 2 Science Parameters
This series of MODIS/Terra images is a small sample of the large Atmosphere and Ocean collection of science parameters that are distributed by the GES DAAC. It depicts a monsoon event (left image), where warm surface waters are pushed inside the Persian Gulf (center image). They are replaced by lower, colder layer waters that in the Gulf are typically nutrient-depleted. This is reflected in the chlorophyll concentration (right image). Events such as this can have a negative impact on local fisheries. The dark areas in the chlorophyll images are caused by the sun glint visible in the true color image (above). Users should be aware that the sun glint is typical for MODIS images, and many algorithms do not yield values in sun glint affected areas. Higher level products provide a sun glint mask to filter affected pixels. (Images created by the MDST at the GES DAAC)

GES DISC DAAC

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